Attorney's Docket No. MTI-31532 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Number:		7,129,128 B2
Issued	:	October 31, 2006
Patentee	:	Ronald A. Weimer
Title	:	Method of Improved High K Dielectric-Polysilicon Interface for CMOS Devices

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CERTIFICATION OF SUBMISSION

I hereby certify that, on the date shown below, this correspondence is being transmitted via the Patent Electronic Filing System (EFS) addressed to Certificate of Correction at the U.S. Patent and Trademark Office.

Date: September 10, 2007 Jill L. Palmatier

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450
ATTENTION: Certificate of Correction Branch

REQUEST FOR CERTIFICATE OF CORRECTION OF PATENT FOR PTO MISTAKE (37 C.F.R. SECTION 1.322(A))

Sir:

It is requested that a Certificate of Correction be issued correcting printing errors appearing in the above-identified United States Patent.

Attached is Form PTO-1050, with the text of the Certificate in the suggested form suitable for printing.

The column and line number where the errors occur in the issued patent are as follows:

Column 5, line 61: Replace "100" with --1mTorr--.

Column 6, line 55: Replace "fanning" with --forming--.

Column 7, line 11: Replace "oxide" with --oxynitride--.

Column 15, line 9: Replace "nitride" with --nitrided--.

Column 15, line 23: After "nitrided" insert --oxide--.

Column 19, line 37: Replace "80020 C" with --800°C--.

Column 21, line 44: Replace "80020 C" with --800°C--.

Column 21, line 65: Replace "80020" with --800°--.

Column 22, line 59: Replace "form" with --from--.

WHD\5297901.1

REMARKS

The errors sought to be corrected in the specification are Patent Office printing errors.

Supporting documentation includes a copy of the relevant page from the specification and Applicant's September 12, 2006 Amendment After Allowance (37 CFR § 1.312), showing the showing the original text to the specification and claim 1 and claims 2, 78, 79, 97, 108, 109 and 149 (renumbered 5, 94, 95, 112, 123, 124, and 127).

The requested corrections are to correct printing errors to conform with the specification and claims as allowed by the Examiner during prosecution. Issuance of a Certificate of Correction would not change either the scope or the meaning of the specification, and re-examination is not required.

As the errors listed are due to Patent Office printing mistakes, no fee is necessary in connection with this Certificate.

The Examiner is requested to contact the undersigned Attorney for Applicant should any questions arise with respect to this Request.

Please send the Certificate of Correction to:

Kristine M. Strodthoff
Whyte Hirschboeck Dudek S.C.
555 East Wells Street, Suite 1900
Milwaukee, WI 53202-3819

Dated: September 10, 2007

Kristine M Strodthoff
Kristine M. Strodthoff, Reg. No. 34259
Attorney of Record

P.O. ADDRESS:

WHYTE HIRSCHBOECK DUDEK S.C.
555 East Wells Street, Suite 1900
Milwaukee, Wisconsin 53202-3819
(414) 273-2100
Customer No. 31870

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. 7,129,128 B2
APPLICATION NO. 09/941,827
ISSUE DATE October 31, 2006
INVENTOR(S) Ronald A. Weimer

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 5, line 61: Replace "100" with --1mTorr--.
Column 6, line 55: Replace "fanning" with --forming--.
Column 7, line 11: Replace "oxide" with --oxynitride--.
Column 15, line 9: Replace "nitride" with --nitrided--.
Column 15, line 23: After "nitrided" insert --oxide--.
Column 19, line 37: Replace "80020 C" with --800°C--.
Column 21, line 44: Replace "80020 C" with --800°C--.
Column 21, line 65: Replace "80020" with --800°--.
Column 22, line 59: Replace "form" with --from--.

MAILING ADDRESS OF SENDER (Please do not use customer number below):
Whyte Hirschboeck Dudek S.C.
555 East Wells Street, Suite 1900
Milwaukee, WI 53202

WHD\5297930.1

atmospheric pressure, to grow a thin oxide layer 20 that is about 40 angstroms or less, and preferably less than 15 ångstroms.

The oxide layer 20 is then exposed to a plasma generated nitrogen species to form a nitrogen-containing layer 24, as shown in **FIG. 3**. The nitride layer 24 on the surface of the oxide layer 20 reduces the effective dielectric constant of the oxide layer 20. Preferably, the nitride layer 24 is about 5 to about 15 angstroms thick, preferably about 10 angstroms, and the oxide layer 20 and the nitride layer 24 collectively have a physical thickness of about 10 to about 40 angstroms, preferably about 10 to about 30 angstroms, preferably about 15 angstroms.

The nitridizing process step can occur in a rapid thermal processor or, preferably, a plasma reactor such as a high density plasma reactor or remote plasma chamber, typically over a temperature range of about 0 C. to about 900°C. Exemplary nitrogen-containing gases include nitrogen (N_2), ammonia (NH_3), nitrogen (N_2) with helium (He), nitrogen (N_2) with argon (Ar), nitrogen oxides (NO_x) including nitrous oxide and nitric oxide, and mixtures thereof.

A preferred nitridization process comprises exposing the wafer 10 to an remote plasma source of nitrogen, preferably a microwave source, at a temperature of about 350 to about 900°C, a pressure of about 1mTorr to about 100 Torr, preferably about 1 to about 10 Torr, with a microwave generated plasma in nitrogen (N_2) and helium at a He:N ratio of about 4:1, and at a flow rate of the nitrogen-containing gas of about 1 to about 5000 sccm, for about 1 to 1800 seconds.

Following nitridization, a dielectric layer 26 is then formed over the nitride layer 24, as depicted in **FIG. 4**, according to techniques known and used in the art. Preferably, the dielectric layer 26 comprises a high dielectric constant (high K) material. "High K" materials are to be distinguished from conventional dielectric materials such as silicon dioxide (k~3.9). Examples of high K materials for dielectric layer 26 include tantalum pentoxide (Ta_2O_5), titanium dioxide (TiO_2), barium strontium titanate (BST), strontium titanate (ST), barium titanate (BT), lead zirconium titanate (PZT), strontium bismuth tantalate (SBT), hafnium oxide (HfO_2), zirconium oxide (ZrO_2), and aluminum oxide (Al_2O_3), being Ta_2O_5 in the illustrated example. The dielectric layer 26 can be formed by a

Acknowledgement Receipt

The USPTO has received your submission at **12:49:24** Eastern Time on **12-SEP-2006** .

No fees have been paid for this submission. Please remember to pay any required fees on time to prevent abandonment of your application.

eFiled Application Information

EFS ID	1196349
Application Number	09941827
Confirmation Number	7551
Title	METHOD OF IMPROVED HIGH K DIELECTRIC-POLYSILICON INTERFACE FOR CMOS DEVICES
First Named Inventor	Ronald A. Weimer
Customer Number or Correspondence Address	31870
Filed By	Thomas Pienkos/Jere Polmatier
Attorney Docket Number	MTI-31532
Filing Date	29-AUG-2001
Receipt Date	12-SEP-2006
Application Type	Utility

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Application Details

Submitted Files	Page Count	Document Description	File Size	Warnings
MTI31532.pdf	32		987256 bytes	◈ PASS

Document Description	Page Start	Page End
Amendment after Notice of Allowance (Rule 312)	1	1
Claims	2	31
Applicant Arguments/Remarks Made in an Amendment	32	32

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

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PATENT

Attorney Docket No. MTI-31532

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Weimer, Ronald A.
Serial No.:	09/941,827
Filing Date:	August 29, 2001
For:	Method of Improved High K Dielectric-Polysilicon Interface for CMOS Devices
Examiner:	PHAM, Thanhha S.
Group Art Unit:	2813
Confirmation No.:	7551

CERTIFICATION OF SUBMISSION

I hereby certify that, on the date shown below, this correspondence is being transmitted via the Patent Electronic Filing System (EFS) addressed to Examiner PHAM at the U.S. Patent and Trademark Office.

Date: September 12, 2006 Jill L. Palmatier

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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT AFTER ALLOWANCE (37 CFR § 1.312)

Sir:

In response to the Notice of Allowance mailed August 3, 2006, Applicant requests the following amendment be made to the above-identified application.

Amendments to the Claims begin on page 2 of this paper.

Remarks begin on page 29 of this paper.

Amendments to the Claims

Please amend the claims as follows:

1. (previously presented) A method of forming a dielectric layer, comprising the steps of:

annealing a polysilicon substrate in nitric oxide to form an oxide layer on the polysilicon substrate;

nitridizing the oxide layer to form a nitride layer on the oxide layer by exposure of the oxide layer to a plasma mixture of nitrogen and helium or nitrogen and argon; and

depositing the dielectric layer onto the nitride layer.

2. (previously presented) A method of forming a dielectric layer, comprising the steps of:

annealing a polysilicon substrate in nitric oxide at a temperature of less than 800°C to form an oxynitride layer on the polysilicon substrate;

nitridizing the oxynitride layer to form a nitride layer on the oxynitride layer by exposure of the oxynitride layer to a plasma mixture of nitrogen and helium or nitrogen and argon; and

depositing the dielectric layer onto the nitride layer.

3. (original) The method of Claim 2, wherein the step of annealing the polysilicon substrate is at a temperature of about 700 to about 750°C.

4. (previously presented) The method of Claim 1, wherein the polysilicon substrate comprises a polysilicon selected from the group consisting of doped polysilicon, undoped polysilicon, and HSG polysilicon.

5. (previously presented) The method of Claim 1, wherein the oxide layer is about 40 angstroms or less.

6. (previously presented) The method of Claim 1, wherein the oxide layer is less than 15 angstroms thick.

annealing the first conductive electrode layer comprising hemispherical grain polysilicon in the presence of nitric oxide at a temperature of about 700 to about 750°C. to form an oxynitride layer having a thickness of about 40 angstroms or less.

63-77. (cancelled)

78. (previously presented) A method of forming a dielectric layer, comprising the steps of:

thermally annealing a polysilicon substrate in nitric oxide to form an oxide layer on the polysilicon substrate; and

annealing the oxide layer in a plasma generated nitrogen gas to nitridize the oxide layer to form a nitrided oxide layer on the oxide layer, the plasma generated nitrogen gas selected from the group consisting of a plasma mixture of nitrogen and helium and a plasma mixture of nitrogen and argon;

wherein upon forming the dielectric layer over the nitridized oxide layer, and exposing the dielectric layer to an oxidizing gas, the nitridized oxide layer inhibits oxidation of the polysilicon substrate.

79. (previously presented) A method of forming a dielectric layer, comprising the steps of:

thermally annealing a polysilicon substrate in nitric oxide to form an oxide layer on the polysilicon substrate;

annealing the oxide layer in a plasma generated nitrogen gas to nitridize the oxide layer to form a nitrided oxide layer on the oxide layer, the plasma generated nitrogen gas selected from the group consisting of a plasma mixture of nitrogen and helium and a plasma mixture of nitrogen and argon; and

forming the dielectric layer over the nitridized oxide layer;

wherein upon exposing the dielectric layer to an oxidizing gas, the nitridized oxide layer inhibits oxidation of the polysilicon substrate.

96. (previously presented) A method of forming a capacitor, comprising the steps of:

forming a first electrode over a substrate, the first electrode comprising polysilicon;

exposing the first electrode to nitric oxide at a temperature of less than about 800°C to form an oxynitride layer thereon having a thickness of about 40 angstroms or less; and

exposing the oxynitride layer to a plasma generated nitrogen gas to nitridize the oxynitride layer to form a nitridized oxynitride layer on the oxynitride layer, the plasma generated nitrogen gas selected from the group consisting of a plasma mixture of nitrogen and helium and a plasma mixture of nitrogen and argon;

wherein upon forming a high K dielectric layer over the nitridized oxynitride layer, and exposing the high K dielectric layer to an oxidizing gas, the nitridized oxynitride layer inhibits oxidation of the first electrode.

97. (previously presented) A method of forming a capacitor, comprising the steps of:

forming a first electrode over a substrate, the first electrode comprising polysilicon;

exposing the first electrode to nitric oxide at a temperature of less than about 800°C to form an oxynitride layer thereon having a thickness of about 40 angstroms or less;

exposing the oxynitride layer to a plasma generated nitrogen gas to nitridize the oxynitride layer to form a nitridized oxynitride layer on the oxynitride layer, the plasma generated nitrogen gas selected from the group consisting of a plasma mixture of nitrogen and helium and a plasma mixture of nitrogen and argon;

forming a high K dielectric layer over the nitridized oxynitride layer; and

exposing the high K dielectric layer to an oxidizing gas;

wherein the nitridized oxynitride layer inhibits oxidation of the first electrode.

98. (previously presented) A method of forming a capacitor, comprising the steps of:

forming a first electrode over a substrate, the first electrode comprising polysilicon;

thermally annealing the first electrode in the presence of nitric oxide at a temperature of less than about 800°C to form an oxynitride layer thereon having a thickness of less than about 15 angstroms; and

generated nitrogen gas selected from the group consisting of a plasma mixture of nitrogen and helium and a plasma mixture of nitrogen and argon;

wherein upon forming a high K dielectric layer over the nitridized oxynitride layer, and annealing the high K dielectric layer in an oxidizing gas, the nitridized oxynitride layer inhibits oxidation of the first electrode.

107. (previously presented) A method of forming a capacitor, comprising the steps of:

providing a substrate, an overlying insulative layer, and a first electrode comprising polysilicon an opening extending through the insulative layer to the substrate;

thermally annealing the first electrode in the presence of nitric oxide at a temperature of less than about 800°C to form an oxynitride layer thereon having a thickness of about 40 angstroms or less;

annealing the oxynitride layer in a plasma generated nitrogen gas to nitridize the oxynitride layer to form a nitridized oxynitride layer on the oxynitride layer, the plasma generated nitrogen gas selected from the group consisting of a plasma mixture of nitrogen and helium and a plasma mixture of nitrogen and argon;

forming a high K dielectric layer over the nitridized oxynitride layer;

annealing the high K dielectric layer in an oxidizing gas, wherein the nitridized oxynitride layer inhibits oxidation of the first electrode; and

forming a second electrode over the high K dielectric layer, the second electrode comprising a conductive material.

108. (previously presented) A method of forming a capacitor, comprising the steps of:

providing a substrate with an overlying insulative layer and an opening extending through the insulative layer to the substrate;

forming a first electrode comprising polysilicon within the opening;

exposing the first electrode to nitric oxide at a temperature of less than about 800°C to form an oxynitride layer thereon having a thickness of about 40 angstroms or less; and

exposing the oxynitride layer to a plasma generated nitrogen gas to nitridize the oxynitride layer to form a nitridized oxynitride layer on the oxynitride layer, the plasma

generated nitrogen gas selected from the group consisting of a plasma mixture of nitrogen and helium and a plasma mixture of nitrogen and argon;

wherein upon forming a high K dielectric layer over the nitridized oxynitride layer, and exposing the high K dielectric layer to an oxidizing gas, the nitridized oxynitride layer inhibits oxidation of the first electrode.

109. (previously presented) A method of forming a capacitor, comprising the steps of:

providing a substrate with an overlying insulative layer and an opening extending through the insulative layer to the substrate;

forming a first electrode comprising polysilicon within the opening;

thermally annealing the first electrode in the presence of nitric oxide at a temperature of less than about 800°C to form an oxynitride layer thereon having a thickness of about 40 angstroms or less; and

annealing the oxynitride layer in a plasma generated nitrogen gas to nitridize the oxynitride layer to form a nitridized oxynitride layer on the oxynitride layer, the plasma generated nitrogen gas selected from the group consisting of a plasma mixture of nitrogen and helium and a plasma mixture of nitrogen and argon;

wherein upon forming a high K dielectric layer over the nitridized oxynitride layer, and annealing the high K dielectric layer in an oxidizing gas, the nitridized oxynitride layer inhibits oxidation of the first electrode.

110. (previously presented) A method of forming a capacitor, comprising the steps of:

providing a substrate with an overlying insulative layer and an opening extending through the insulative layer to the substrate;

forming a first electrode comprising polysilicon within the opening;

thermally annealing the first electrode in the presence of nitric oxide at a temperature of less than about 800°C to form an oxynitride layer thereon having a thickness of about 40 angstroms or less;

annealing the oxynitride layer in a plasma generated nitrogen gas to nitridize the oxynitride layer to form a nitridized oxynitride layer on the oxynitride layer, the plasma

the group consisting of a plasma mixture of nitrogen and helium and a plasma mixture of nitrogen and argon; and

depositing the dielectric layer onto the silicon nitride layer.

149. (previously presented) A method of forming a dielectric layer, comprising the steps of:

annealing a polysilicon substrate in nitric oxide at a temperature of less than 800°C to form an oxide layer on the polysilicon substrate;

nitridizing the oxide layer after the step of annealing in a plasma generated nitrogen gas to form a silicon nitride layer on the oxide layer, the plasma generated nitrogen gas selected from the group consisting of a plasma mixture of nitrogen and helium and a plasma mixture of nitrogen and argon;

depositing the dielectric layer onto the silicon nitride layer; and

exposing the dielectric layer to an oxidizing gas, wherein oxidation of the polysilicon substrate is inhibited.

150. (previously presented) The method of Claim 2, wherein the nitride layer is about 5 to about 15 angstroms thick.

151. (previously presented) The method of Claim 2, wherein the oxynitride layer and the nitride layer have a combined thickness of about 10 to about 30 angstroms.

152. (previously presented) The method of Claim 2, wherein the step of nitridizing comprises exposing the oxynitride layer to a remote plasma source of nitrogen.

153. (previously presented) The method of Claim 2, further comprising saturating the dielectric layer with oxygen.

154. (currently amended) The method of Claim 153, wherein the step of saturating comprises subjecting the dielectric layer to an oxygen anneal in ~~a presence of~~ an oxidizing gas.